

CLAIMS

What is claimed and desired to be covered by Letters Patent is:

1. An electrode with three-dimensional capabilities for detection and control of brain state changes of a subject, comprising:
 - (a) a body mechanism including:
 - (1) a disk portion having an upper surface and a lower surface, and
 - (2) a shaft portion secured to and extending perpendicularly outwardly from the lower surface of the disk portion; the shaft portion having an outer surface;
 - (b) at least one recording or stimulating contact surface structured to operatively interact with the brain of a subject; and
 - (c) at least one conductor structured to operatively connect each at least one recording or stimulating contact surface in communication with external apparatus.
2. The electrode as described in claim 1 wherein the at least one recording or stimulating contact surface is positioned on the lower surface of the disk portion.
3. The electrode as described in claim 2 wherein the at least one recording or stimulating contact surface includes an annularly shaped recording or stimulating

contact surface.

4. The electrode as described in claim 2 wherein the at least one recording or stimulating contact surface includes a circularly shaped recording or stimulating contact surface.
5. The electrode as described in claim 4 wherein the at least one recording or stimulating contact surface has a diameter between approximately 1 - 5 mm.
6. The electrode as described in claim 1 wherein the at least one recording or stimulating contact surface is positioned on the outer surface of the shaft portion.
7. The electrode as described in claim 1 wherein the at least one recording or stimulating contact surface comprises a plurality of recording or stimulating contact surfaces separated by insulating material.
8. The electrode as described in claim 7 wherein at least one of the plurality of recording or stimulating contact surfaces is positioned on the lower surface of the disk portion.
9. The electrode as described in claim 7 wherein at least one of the plurality of recording or stimulating contact surfaces is positioned on the outer surface of the

shaft portion.

10. The electrode as described in claim 1 wherein the disk portion and shaft portion form a tack-like configuration.
11. The electrode as described in claim 1 wherein the disk portion is integrally formed with the shaft portion.
12. The electrode as described in claim 1 wherein the disk portion has a diameter between approximately 1 - 25 mm.
13. The electrode as described in claim 1 wherein the shaft portion has a diameter between approximately 0.1 - 1.0 mm.
14. The electrode as described in claim 1 wherein the disk portion and the shaft portion are structured to simultaneously record both from an exposed surface of the cortex and from depths of the cortex of the brain of a subject.
15. The electrode as described in claim 1 wherein the body mechanism is constructed of biocompatible material.

16. The electrode as described in claim 1 wherein at least a portion of the body mechanism is constructed of polyurethane covered with thin sheets or coatings of noble metals.
17. The electrode as described in claim 1 wherein at least a portion of the body mechanism is constructed of polyurethane covered with thin sheets or coatings of platinum.
18. The electrode as described in claim 1 wherein the disk portion, in conjunction with the shaft portion, is structured to operatively provide support and anchoring for the shaft portion.
19. The electrode as described in claim 1 wherein the shaft portion, in conjunction with the disk portion, is structured to operatively provide support and anchoring for the disk portion.
20. The electrode as described in claim 1 wherein the disk portion and the shaft portion are structured to operatively provide support and anchoring for each other.
21. The electrode as described in claim 1 wherein the at least one recording or stimulating contact surface is constructed of inert conductive material.

22. The electrode as described in claim 1 wherein the at least one recording or stimulating contact surface is constructed of platinum.
23. The electrode as described in claim 1 wherein the at least one recording or stimulating contact surface is constructed of platinum-iridium.
24. The electrode as described in claim 1, further including electrical insulation on the conductors throughout the shaft portion and continuing to the juncture between the conductor and the corresponding at least one contact surface.
25. An electrode with three-dimensional capabilities for detection and control of brain state changes of a subject, comprising:
- (a) a disk portion having an upper surface and a lower surface, and
 - (b) a shaft portion secured to and extending perpendicularly outwardly from the lower surface of the disk portion; the shaft portion having an outer surface;
 - (c) a plurality of recording or stimulating contact surfaces structured to operatively interact with the brain of a subject; at least one of the plurality of recording or stimulating contact surfaces positioned on the lower surface of the disk portion and having a circular or annular shape; at least one of the plurality of recording or stimulating contact surfaces positioned on the outer surface of the shaft portion;

- (d) insulating material isolating each of the plurality of recording or stimulating contact surfaces from each other; and
- (e) at least one conductor structured to operatively and separately connect each of the plurality of recording or stimulating contact surfaces in communication with external apparatus; and

wherein the disk portion and the shaft portion are structured relative to each other to operatively provide support and anchoring for each other while providing three-dimensional capabilities for detection and control of brain state changes of a subject.

26. An electrode with three-dimensional capabilities for detection and control of brain state changes of a subject, comprising:

- (a) a body mechanism including:
 - (1) a disk portion having an upper surface and a lower surface, and
 - (2) a hollow shaft portion secured to and extending perpendicularly outwardly from the lower surface of the disk portion; the shaft portion having an inner surface and an outer surface;
- (b) at least one electrode device pivotally mounted on the inside surface of the hollow shaft portion and having a distal end structured to operatively provide recording or stimulating contact with the brain of a subject;
- (c) at least one conductor structured to operatively and separately connect the distal end of each at least one electrode device in communication with

external apparatus; and

- (d) at least one activating mechanism structured to operatively and selectively cause a respective at least one electrode device to insert and retract the corresponding distal end into and from brain tissue of the subject spaced adjacent thereto.

27. The electrode as described in claim 26, further comprising:

- (a) at least one recording or stimulating contact surface positioned on the outer surface of the hollow shaft portion; and
- (b) at least one conductor structured to operatively and separately connect each at least one recording or stimulating contact surface in communication with external apparatus.

28. The electrode as described in claim 26, wherein the at least one activating mechanism includes a pair of control wires trained through the center opening wherein one of the pair of control wires causes the distal end of the respective at least one electrode device to be inserted into and brain tissue of the subject spaced adjacent thereto and the other one of the pair of control wires causes the distal end of the respective at least one electrode device to be retracted from brain tissue of the subject spaced adjacent thereto.

29. The electrode as described in claim 26, wherein the at least one activating mechanism includes a stepper motor structured to operatively and selectively cause the distal end of the respective at least one electrode device to be inserted into and retracted from brain tissue of the subject spaced adjacent thereto.
30. An electrode with three-dimensional capabilities for detection and control of brain state changes of a subject, comprising:
- (a) a body mechanism including:
 - (1) a disk portion having an upper surface and a lower surface, and
 - (2) a solid shaft portion secured to and extending perpendicularly outwardly from the lower surface of the disk portion; the shaft portion having an outer surface;
 - (b) at least one channel formed in the disk portion and solid shaft portion wherein each at least one channel has an upper end and a lower end and wherein the upper end exits generally perpendicularly from the upper surface of the disk portion and the lower end exits generally perpendicularly from the outer surface of the solid shaft portion;
 - (c) at least one electrode wire structured to be operatively and slidably inserted through the at least one channel such that a distal end of the electrode wire can be selectively inserted into brain tissue of the subject spaced adjacent to the lower end of the respective channel.

31. The electrode as described in claim 30, further including a cannula slidably inserted through each at least one channel between the at least one channel and the electrode wire therein such that the cannula and the electrode wire are separately and selectively lengthwise slidable relative to each other and to the channel.
32. The electrode as described in claim 30, further including:
- (a) a first activating mechanism for separately extending and retracting the at least one cannula relative to the respective channel and electrode wire therethrough to extend and retract the respective distal end of the cannula into and from brain tissue spaced adjacent to the lower end of the respective channel; and
 - (b) a second activating mechanism for separately extending and retracting the electrode wire relative to the respective channel and cannula therethrough to extend and retract the respective distal end of the electrode wire into and from brain tissue spaced adjacent to the lower end of the respective channel.
33. An electrode with three-dimensional capabilities for detection and control of brain state changes of a subject, comprising:
- (a) a body mechanism including:
 - (1) a plate portion having an upper surface and a lower surface, and

- (2) a plurality of shaft portions secured to and extending perpendicularly outwardly from the lower surface of the plate portion; each shaft portion having an outer surface;
 - (b) at least one recording or stimulating contact surface positioned on the outer surface of at least one of the plurality of shaft portions, the at least one recording or stimulating contact surface structured to operatively interact with the brain of a subject; and
 - (c) at least one conductor structured to operatively connect a different one of each at least one recording or stimulating contact surface in communication with external apparatus.
34. The electrode as described in claim 33, further comprising the at least one recording or stimulating contact surface including one or more recording or stimulating contact surfaces positioned on the lower surface of the plate portion.